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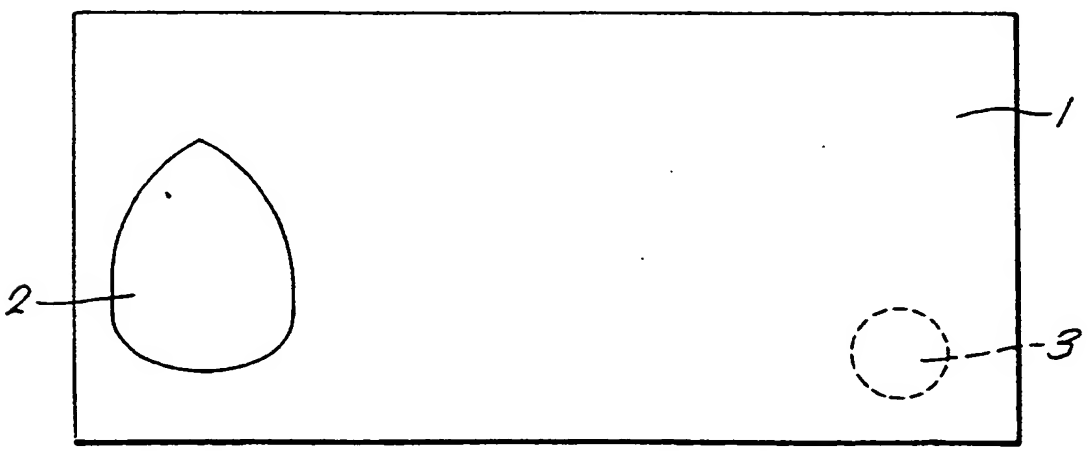
(54) Sheet with security device.

(57) A sheet (1), such as a banknote, has a security device comprising a see-through or print-through feature. The feature is provided in a region (3) of the sheet (1) which has a substantially uniform transparency and which is more transparent than a majority of the remainder of the sheet in the absence of applied ink.

Fig.1.



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SHEET WITH SECURITY DEVICE

The invention relates to a sheet having a security device and a method of manufacturing such a sheet.

In the field of security documents, such as banknotes and the like, there is a continuing need to incorporate security devices which prevent such security documents from being counterfeited using the increasingly sophisticated commercial printing equipment which is available.

Examples of security devices which have been used in the past include complex patterns printed on the document, optical devices such as diffraction gratings and holograms and the like.

For certain translucent papers a security feature which involves providing (usually printing) an image on both sides of the paper was developed many years ago. In one form, herein defined as a "see-through" feature, complementary images are provided on each side of the sheet precisely registered relative to one another such that when the sheet is held up to the light, the image on the back will fit exactly into spaces within the image on the front, optionally with an even unprinted margin around the perimeter. For example, each image could comprise a series of black circles the circles on one side of the sheet fitting within the spaces between circles on the other. Printing of these images is normally carried out with specialised lithographic presses which allow simultaneous front and back printing during one printing run. In this way, the tolerances applied to the design elements are typically a fraction of a millimetre and any variation caused by counterfeiting by printing both sides during different printing runs can be quickly noticed. By printing on both sides in a single impression, misregister due to variations in the dimensions of the sheet caused by change of moisture content or heating and the like are avoided.

A second feature based on the same principle is herein defined as a "print-through" feature. In this case, an image and its reverse are printed on each side of the sheet, in register, so that when the sheet is held up to the light the image on one side of the sheet substantially conceals the image on the other side of the sheet. There should be no change in appearance of the image due to misregister. It is possible, however, for the two images to be printed in different colours which may include rainbow printing effects.

Both see-through and print-through features have four modes of visual inspection - the first image viewed in reflected light, the image on the other side of the sheet viewed in reflected light, the composite image viewed by transmitted light as viewed from the first side and with the image on that side predominating, and finally the composite image as viewed on the other side of the sheet with the image on that side predominating. On transmissive viewing of see-through features the image on the opposite side of the sheet is seen to be in register in a genuine document. On transmissive viewing of print-through features the image on the opposite side of the sheet is not seen in a genuine document but slight misregister will reveal that the document is a counterfeit.

The printed images are generally graphical designs although alphanumeric characters which appear identical in mirror reflection may be employed. The printed images may be of the same ink colour on both sides of the sheet which will give the impression of the printing ink having penetrated through the document or the colours may be different. The print-through feature image on one side of a sheet may comprise two different printed portions on at least one side of the sheet, which may be printed in different colours. Alternatively the printed image may be formed by continuously varying colour as in security rainbow printing methods.

Security document designers frequently combine a number of individual see-through features to make composite designs with those characteristics. See-through and print-through features will sometimes be combined to give a composite overall design feature which may cover a large portion of the note eg. up to 25%.

Until now these see-through and print-through security features have best been utilised in banknotes of relatively low basis weight and have been restricted to white or near-white papers. The heavier weight papers frequently found in the more durable currencies have too high an opacity for effective use of such features. Similarly coloured papers have too high an opacity to allow ready observation of these features.

In accordance with one aspect of the present invention, we provide a sheet having a security device comprising a see-through or print-through feature, as hereinbefore defined characterised in that the feature is provided in a region of the sheet which has a substantially uniform transparency and which is more transparent than a majority of the remainder of the sheet in the absence of applied ink.

In accordance with a second aspect of the present invention, a method of manufacturing a sheet having a security device comprises providing a sheet with a region which has a substantially uniform transparency and which is more transpar-

ent than a majority of the remainder of the sheet in the absence of applied ink; and providing a see-through or print-through feature as hereinbefore defined, in the said region.

We have proposed a new type of sheet in which a security device having a see-through or print-through feature can be provided even though a majority of the sheet itself is substantially opaque to light.

The invention is particularly applicable for use with coloured and relatively heavy security paper substrates which exhibit a high absorbance and with which see-through and print-through features have not previously been found to give satisfactory performance. These features have therefore previously been confined to lighter weight white papers. However, with the invention the advantages of these features can be used on previously unacceptable substrates. This makes the invention particularly applicable to security documents which undergo frequent use such as banknotes. The invention is applicable, however, to various types of sheet substrate stock such as paper, including rag paper, paper-plastic laminates, plastic coated paper, translucent plastic and the like. Frequently, however, the sheet comprises rag paper to which security printing is applied to form a banknote.

Normally, the radiation with which the images can be detected is in the visible band.

The security device of the invention may be used in any suitable two side security printed documents such as banknotes, cheques including bank and travellers' cheques and passports, bonds, certificates, tickets, passes, plastic cards (such as financial cards, bank cards, credit cards, charge cards, guarantee cards, service entitlement cards), integrated circuit containing cards, identity cards, and licence documents.

The transparency of such items may be automatically measured when the item is presented for machine processing such as banknote sorting.

Preferably, the features substantially fill the region of uniform transparency although a plane perimeter region may be provided.

As already mentioned, the images printed in the region may be similar to those used conventionally to define see-through or print-through features. In addition, these features may be varied so that instead of whole evenly toned printing being employed, the images may be made from intermeshing geometric arrangements. Such arrangements include parallel spaced line patterns, for example with the space and line widths being identical, such that when the composite is viewed by transmission the lines alternately overlap to give the impression of a solid figure. Concentric circles or other curvilinear shapes may also be employed. A further alternative is an intermeshing pattern of orthogonally orientated lines of equal line and space width which when viewed by transmission give an overlapping pattern of squares having either no overlap, a single overlap or double overlap. Poor registration will cause this effect to be noticably changed. A further alternative, described in DE-C-3208204 is a periodic line or points pattern which on counterfeiting gives a moire pattern.

The images can be printed in monochrome or polychrome or a combination of the two.

The inks which may be employed are lithographic inks including coloured inks, white inks, black inks, metallic inks, optically variable inks (such as those incorporating thin film optical interference filters) and the like. Thermochromic inks, photochromic inks, fluorescing and phosphorescing inks visibly may also be employed. The inks may be employed in rainbow printing fashion.

The images may also be printed with white or colourless substances which are difficult to detect by eye but which are detectable by machine sensing, such as X-ray absorptive inks. Using such a technique the security feature will only be made viewable on an X-ray photograph.

Preferably, the step of providing a sheet comprises manufacturing the sheet such that the weight per unit area of the sheet in the region of uniform transparency is less than the weight per unit area in the majority of the remainder of the sheet. Preferably, this is achieved by the use of a watermarking technique such as by using mould or dandy roll methods but in which there is substantially no variation in transmission to radiation within the region.

The use of abrasion to remove a proportion of paper from an area (which may be presented in relief to allow paper removal in patterned form) may also be employed.

As an alternative, for relatively thin sheets, the majority of the sheet can be made substantially more opaque than the region to carry the images using dyes and the like. In a further alternative, such reduction in transparency may be achieved by methods of electroless deposition of metals as taught in JP63219694A (Dai Nippon Printing KK) in which the metal deposits inside the paper without discoloration.

For a mould-made watermarked white paper, if the non-watermarked areas have an average relative transmission of 1.00, then the planar region in which the security device is provided preferably has a relative transmission of 1.05 to 1.25, most preferably 1.10 to 1.20. The shadow areas of graphical watermarks in such watermark papers may be in the range of 0.95 to 0.65, preferably 0.90 to 0.80. A particular example of a mould marked paper (prior to any printing) had a relative transmission of 1.00 in its unwatermarked areas, a

maximum relative light transmission of 1.17 in the highlights and a minimum of 0.85 in the shadow areas of the graphical watermark.

For a dandy roll made watermarked white paper, the relative planar region transmissions which are preferred are similar to that for a mould-made watermarked white paper. A particular example of a dandy roll marked paper had a relative transmission of 1.00, a maximum relative light transmission of 1.17 in the highlights and a minimum of 0.89 in the shadow areas of the graphical watermark.

The variation in transmission of the unwatermarked areas prior to printing will normally be within 2%.

It should be understood that the reference above to "watermarked" paper is simply to indicate that the region in which the security device is provided has been manufactured using a watermarking technique although the region created to carry the images has a substantially uniform or even transparency.

In addition to this region, however, it is preferable if the sheet also includes a conventional (ie. graphical) watermark. This graphical watermark should be separate from the region having the security device and may be made in any conventional manner, typically the same manner as that used to make the security device region but additionally imparting a variation in the translucency of the paper. For example, there may be a mould-made mark which is a three dimensional image created within the body of the paper during the manufacturing process. It consists of a controlled variation of paper weight on a small scale which permits more or less light to pass through the paper forming areas of light and shadow which make up the graphical watermark image.

Typically, the region containing the security device will have an area of between 0.4 and 5cm^2 and although generally will be separate from other graphical watermark features, it could form part of a larger composite watermark. Areas greatly in excess of 5cm^2 are undesirable less the strength of the document is compromised.

In general, the region containing the security device will have a reduction in opacity of typically up to 40% of the average opacity of the sheet. This figure may be greater, that is the contrast between the general background areas of the sheet and the security device region may be greater if the base is itself coloured.

The process for printing the see-through or print-through features is normally twin offset lithographic although twin dry offset lithography and twin intaglio may be used. In order to achieve the precise register the image component on one side of the sheet is printed at the same time at its counterpart on the other side of the sheet. Thus the two components are applied during one printing impression, not from separate impressions even during the same pass through the printing press. The combination of lithography and intaglio will not normally give sufficient register to be practicable.

The planar watermarked area for use with these features must be even in translucency over the area of the feature with which it is designed to be used. Conventional watermarking of banknote and similar security paper causes many deliberate changes in translucency in order to depict the graphical watermark. The areas of given high translucency in conventional watermarks are generally too small for use with see-though and print-through features. In some cases, the region containing the see-through and print-through feature will be on its own, in others it may abut or be contained within a conventional graphical watermark.

Normally, the region containing the see-through or print-through feature will wholly contain the feature and leave a margin to allow for variation in register between the region and the feature. This is not however essential. Thus for example within a large conventional see-though or print-through feature there may be contained a feature according to the invention. The region incorporating this feature fits inside the conventional feature but sufficiently circumscribes the printing which is to be viewed in combination with the region. The overall effect of a localised feature according to the invention, which is contained within a larger area of see-through and/or print-through printing is to create a highlight area.

A security document such as a banknote may contain a selection of see-through and print-through features and individual design elements may include portions of both.

In the case where the security device region is made more transparent to radiation using a watermarking technique, account must be taken of the fact that the watermarking process gives less precise register than that achievable by double sided precision register lithographic printing. In view of this, the region contained in the security device will normally be made larger than the images themselves, typically by 3mm in each direction. The registration of the security device region and the images need not therefore be as accurate as between the images themselves.

A further advantage of making use of the watermarking technique is that counterfeiting is made more difficult by combining this technique with double sided precision lithographic printing.

The final registration between the images on each side of the sheet should fall within a tolerance of 0.1mm.

If the planar region is made by changing the basis weight of the paper locally, then it is desir-

able that this area of reduced weight does not extend over the edge of the sheet having the security device in order not to reduce the durability of the document.

In accordance with a third aspect of the present invention, security printable substrate stock comprises a region which has a substantially uniform transparency and which is more transparent than a majority of the remainder of the sheet in the absence of applied ink. For example the stock may comprise paper, preferably banknote paper and may include, separate from the transparent region, one or more of a security thread, a graphical watermark, security fibres, and planchettes.

The substrate stock may include a sheet having at least twelve such regions and advantageously forms a roll having at least 1000 such regions.

Some examples of banknotes according to the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 illustrates one face of a banknote showing a watermark region and a region of even translucency;

Figure 2 illustrates one image of a combined see-through and print-through device;

Figure 3 illustrates the other image of the device of Figure 2;

Figure 4 illustrates the appearance of the device of Figures 2 and 3 when viewed with transmitted light;

Figure 5 illustrates the device of Figures 2 to 4 on the banknote of Figure 1;

Figure 6 illustrates another banknote having a print-through device; and,

Figures 7A and 7B illustrate respectively a cross-section through a partially printed banknote and a graph showing transmittance along the cross-section.

Figure 1 illustrates a banknote 1 containing a conventional graphical watermark 2 illustrated in outline and an area of even transparency 3.

Figure 2 represents the front view of the portion of a combined see-through and print-through device (not shown in Figure 1) which is printed on the front of the banknote 1 in the area 3 and in which the black areas are printed areas. This consists of a perimeter outline of a figurine 4, background shading 5 and an overall perimeter 6A. It is all contained within the area of even transparency 3 (not shown in Figure 2).

Figure 3 represents the view of the other portion of the device, printed on the back of the banknote 1 and viewed from that aspect. It is similarly contained within the area of even transparency 3 (not shown in Figure 3). It consists of a solid figurine 7, which may be rainbow printed, within an unprinted background 8 and confined by a perimeter 6B of the same dimensions as that in Figure 2.

Figure 4 represents the front view of the device when inspected by transmitted light. Within the area of even transparency 3 (not shown in Figure 4) is located the composite device. The figurine is revealed to be in such accurate register that it fits within the confines of the front printed portion and is surrounded by an even unprinted margin 9. This illustrates the see-through feature.

The perimeters of the portions 6A and 6B of the two printings constituting the device are printed in such accurate register that they overlap to form perimeter line 10 which has exactly the same dimensions as components 6A and 6B. This forms the print-through feature. From inspection of the device in transmitted light it is not obvious to the casual viewer that the line 6B is behind 6A.

Figure 5 shows the relative position of the device within the final banknote as viewed by transmitted light.

Figure 6 represents the appearance from the front and by transmitted light of a similar device 11 which is entirely a print-through device, with the elements being composed in similar manner to the previous example, but with the entire element being printed in register on both sides of the paper. In this instance the mirror image of the design 11 shown in Figure 6 as being on the front of the note is printed on the back in absolute register.

Figure 7A shows the banknote 1 provided with the area of even transparency 3 in which is printed a figurine 2 similar to the figurine 7. The banknote 1 has been further provided, by means of printing, with a solid figurine 13 elsewhere in the majority of the sheet. The light transmittance through the partly printed document is thus characterised by four values as shown in Figure 7B. Value A is the light transmittance through the majority of the sheet; Value B is the light transmittance through the area of even transparency 3; Value C represents the light transmittance through the area provided with the solid figurine 13; and Value D represents the light transmittance through the area of even transparency 3 provided with the solid figurine 12.

The light transmittance measurements were made with the light source on the same side as the solid printed figurines 12 and 13 and detection on the side remote from the figurines. The contrast between print and paper when the print is viewed through the paper may be defined in terms of these four values. Contrast P representing the print contrast for the solid figurine 13 printed on the majority of the sheet may be defined as Value A minus Value C. Similarly Contrast T representing the print contrast for the solid figurine 12 printed in the area of greater transparency 3 may be defined as Value B minus Value D. The increase in contrast represented by the increase of Contrast T over

Contrast P is thus a measure of the improvement in the clarity of a see-through feature of the invenion.

Example 1

A white sheet of paper of approximately 85 gsm was made on a laboratory sheet former. An area of greater transparency was provided during the forming of the sheet. The sheet was printed with a suitable solid image using black ink in the area of the greater transparency and elsewhere on the majority of the sheet. Light transmission measurements calculated from transmission densitometer readings gave the characteristic values as described above of Value A = 31.4%, Value B = 47.1%, Value C = 1.8% and Value D = 3.7%. Thus we may calculate Contrast P = 29.6% and Contrast T = 43.4%, an improvement of 13.8% in print contrast.

Example 2

A white sheet of paper of approximately 95 gsm was formed and printed as described in Example 1. Characteristic light transmission levels were Value A = 25.7%, Value B = 41.2%, Value C = 7.8% and Value D = 11.6%. The relevant print contrast values are thus Contrast P = 17.9% and Contrast T = 29.6%, an improvement in print contrast of 11.7%.

Example 3

A pink coloured sheet of paper of approximately 95 gsm was formed and printed as in Example 1. Characteristic light transmission levels were Value A = 12.9%, Value B = 30.9%, Value C = 3.5%, and Value D = 7.2% giving print contrasts of Contrast P = 9.4% and Contrast T = 23.7%, an improvement of 14.3%.

Claims

1. A sheet (1) having a security device comprising a see-through or print-through feature, as hereinbefore defined characterised in that the feature is provided in a region (3) of the sheet (1) which has a substantially uniform transparency and which is more transparent than a majority of the remainder of the sheet in the absence of applied ink.

2. A sheet according to claim 1, wherein the sheet comprises paper, paper-plastic laminate, plastic coated paper, or translucent plastic.

3. A sheet according to any of the preceding claims, wherein the feature is printed using a white or colourless substance which is detectable by machine sensing.

4. A sheet according to any of the preceding claims, further comprising a graphical watermark separate from the region (3) having the security device.

5. A sheet according to any of the preceding claims, wherein the region containing the security device has an area between 0.4 and 5cm^2.

6. A sheet according to any of the preceding claims, wherein the region containing the security device has a reduction in opacity relative to the remainder of the sheet in the absence of applied ink of up to 40% of the average opacity of the sheet.

7. A sheet according to any of the preceding claims for use as a security printed document.

8. A sheet according to any of the preceding claims, wherein the feature is printed on the sheet.

9. A method of manufacturing a sheet having a security device, the method comprising providing a sheet with a region which has a substantially uniform transparency and which is more transparent than a majority of the remainder of the sheet in the absence of applied ink; and providing a see-through or print-through feature as hereinbefore defined, in the said region.

10. A method according to claim 9, wherein the step of providing a sheet comprises manufacturing the sheet such that the weight per unit area of the sheet in the region of uniform transparency is less than the weight per unit area in the majority of the remainder of the sheet.

11. A method according to claim 9 or claim 10, wherein the feature is printed on the sheet.

12. A method according to any of claims 9 to 11, wherein the region is formed using a watermarking process.

13. Security printable substrate stock comprising a region which has a substantially uniform transparency and which is more transparent than a majority of the remainder of the sheet in the absence of applied ink.

14. Stock according to claim 13 which comprises banknote paper.

15. Stock according to claim 13 or claim 14, the stock including one or more of a security thread, a watermark, security fibres, and planchettes.

16. Stock according to any of claims 13 to 15, wherein the region has an area of between 0.4 and 5 cm^2.

17. Stock according to any of claims 13 to 16, the stock having at least twelve such regions.

18. A roll of paper stock according to claim 17,

the roll having at least 1000 such regions.

19. A sheet having a security device according to any of claims 1 to 8 manufactured from paper stock according to any of claims 13 to 18.

Fig.1.

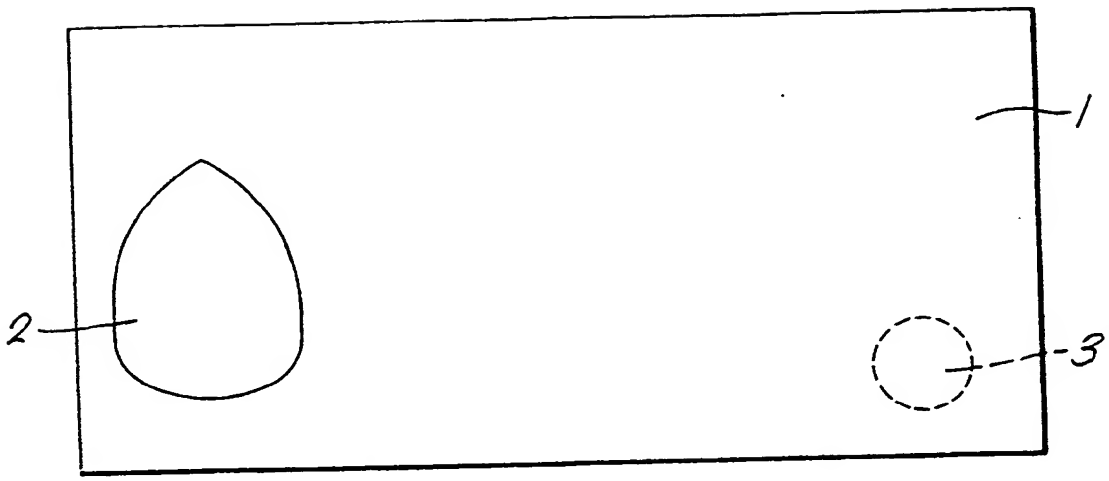
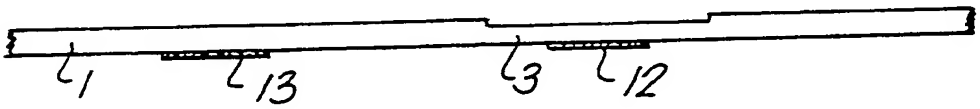


Fig.7. (A)



(B)

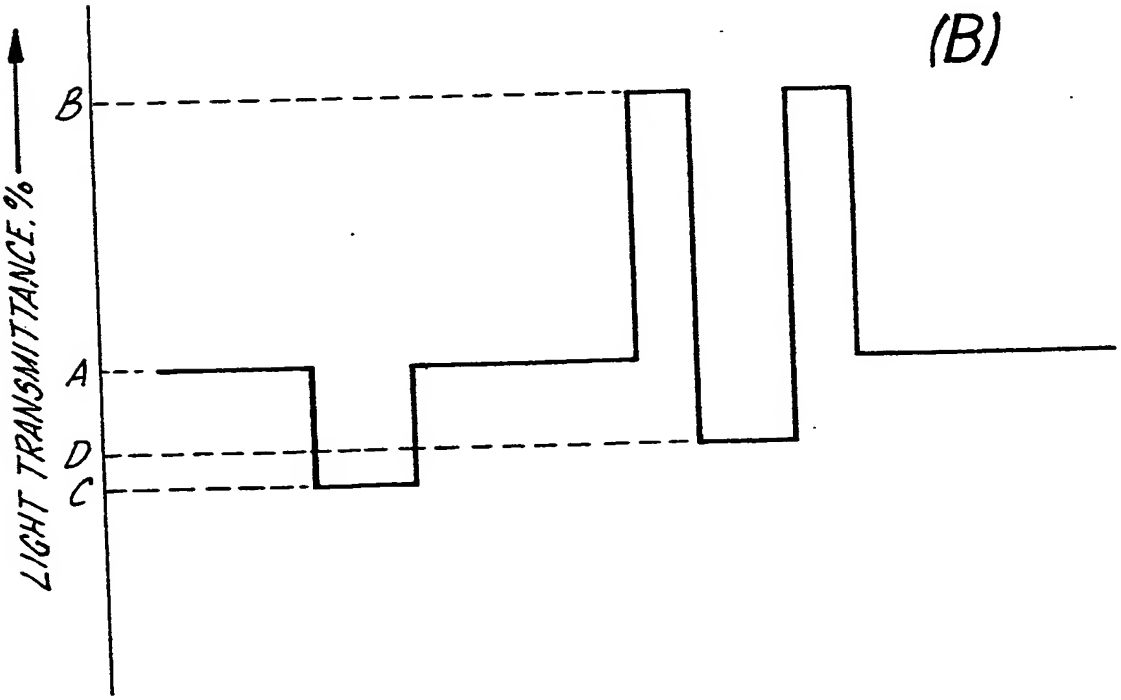


Fig.2.

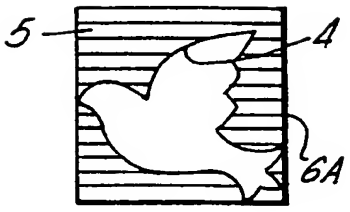


Fig.3.

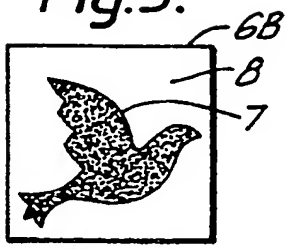


Fig.4.

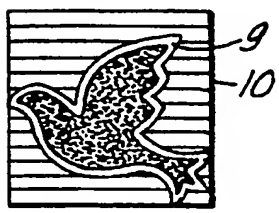


Fig.5.

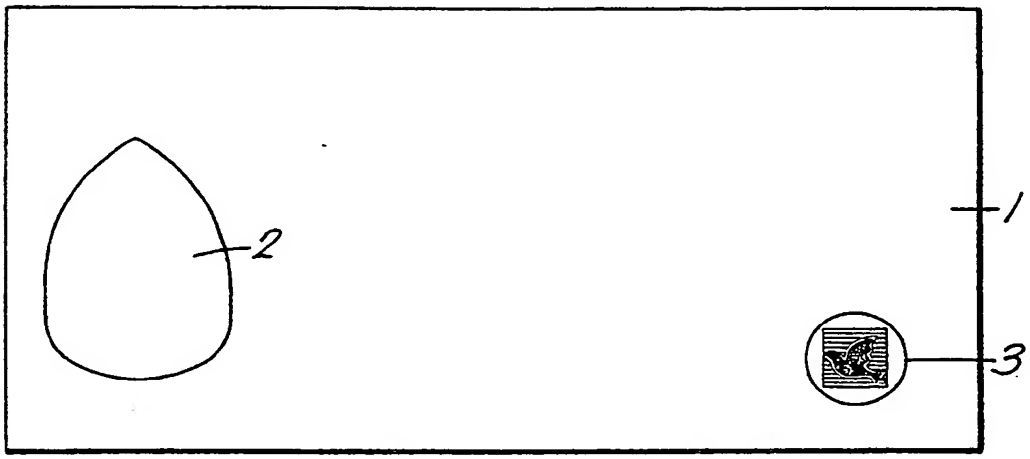
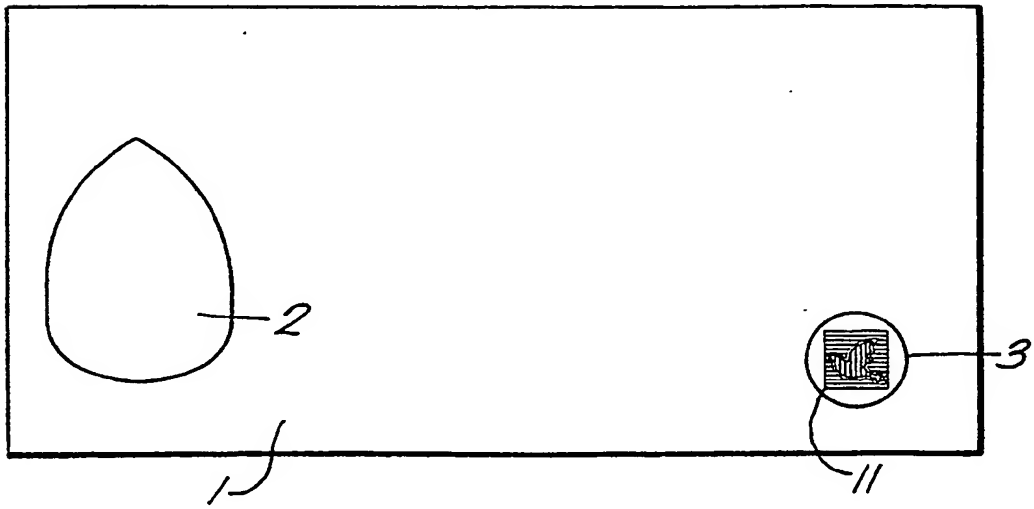


Fig.6.



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 30 2524

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8300766 (GALLAGHER) * page 4, line 33 - page 5, line 20; figures 4, 5 *	1, 2, 4-9	B42D15/00
Y		3	
Y	DE-B-2901150 (GAO) * the whole document *	3	
X	GB-A-315528 (WATERLOW & SONS LIMITED) * the whole document *	1-2, 7, 8, 9	
Y		10, 11, 12, 13	
Y	CA-A-1116851 (FRANK, JOHN F.) * the whole document *	10, 11, 12, 13	
A	EP-A-156463 (BURROUGHS CORPORATION) * the whole document *	1, 2	
A	DE-A-2511368 (GAO) * the whole document *	1, 2	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	US-A-3366531 (P.H. LONG) * the whole document *	9, 10	B42D B41M B44F
A	DE-C-62053 (A.B. DRAUTZ) * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05 JULY 1990	MEULEMANS J.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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